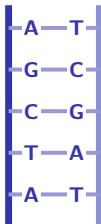


Nucleic Acids & Protein Synthesis

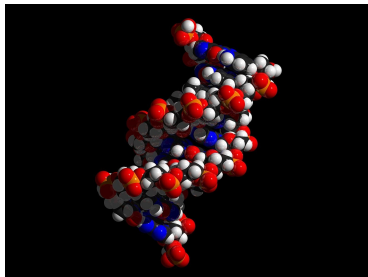
A-Level Biology ■ Topic 6

A-Level Biology



What we will cover

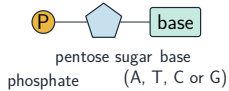
- 1 Nucleotides & bases
- 2 DNA structure
- 3 DNA replication
- 4 The genetic code
- 5 Transcription & translation
- 6 Mutations



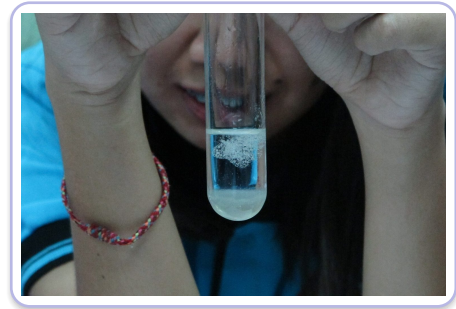
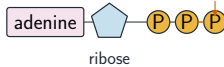
the DNA double helix

Nucleotides

a nucleotide

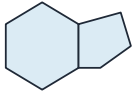


ATP energy released when this P breaks off



dna extraction

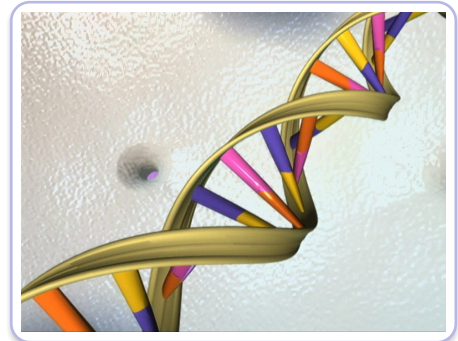
The five bases



purine
double ring (A, G)

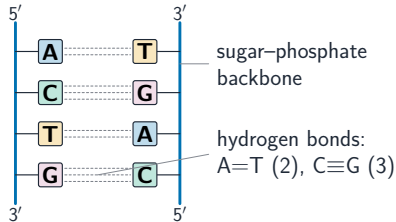


pyrimidine
single ring (C, T, U)



rna dna model

DNA structure

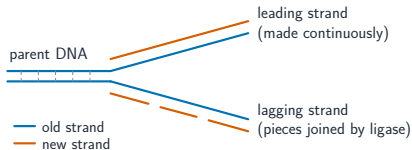


the two strands run in opposite directions (antiparallel)

Two **antiparallel** 反平行 strands twist into a **double helix** 双螺旋.

Complementary base pairing 碱基互补配对: A-T by 2 hydrogen bonds, C-G by 3 – joined along a **phosphodiester** 磷酸二酯键 backbone.

DNA replication



each new molecule = one old strand + one new strand (semi-conservative)

Replication is **semi-conservative** 半保留复制 – each new molecule keeps one old strand.

- **DNA polymerase** 聚合酶 adds nucleotides $5' \rightarrow 3'$
- **leading strand** 前导链 continuous; **lagging strand** 后随链 in pieces, joined by **ligase** 连接酶

The genetic code

gene 基因 → polypeptide

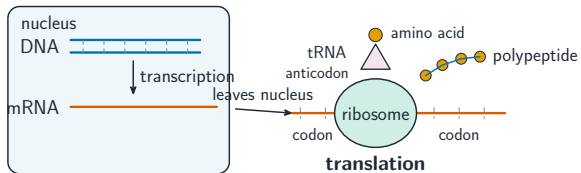
triplet 三联体 = 3 bases

universal 通用

64 triplets, 20 amino acids $\Rightarrow$ most amino acids have more than one triplet

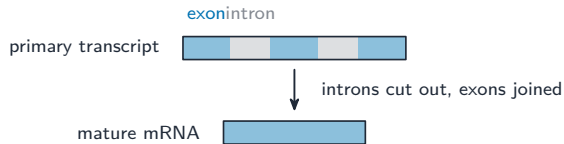
RNA 核糖核酸 is a single strand with the sugar **ribose** 核糖, and uses **uracil** 尿嘧啶 in place of thymine.

Transcription and translation



- **transcription** 转录 – DNA → mRNA 信使 RNA in the nucleus
- **translation** 翻译 – the ribosome reads **codons** 密码子; **tRNA** 转运 RNA **anticodons** 反密码子 bring amino acids

Splicing



In eukaryotes the first transcript has coding **exons** 外显子 and non-coding **introns** 内含子.

Splicing 剪接 cuts out the introns and joins the exons to make the finished mRNA.

Gene mutations

original **A****T****G** **C****A****T** **T****A****C**

substitution **A****A****G** **C****A****T** **T****A****C**

deletion **A****T****G** **A****T****T** **A****C**

insertion **A****T****G** **G****C****A** **T****T****A** **C**

red = changed base; shaded = shifted by a frameshift (deletion or insertion)

A **mutation** 突变 changes the base sequence:

- **substitution** 替换 – swaps one base (small effect)
- **deletion** 缺失 / **insertion** 插入 – shift every later triplet (a **frameshift** 移码)

Worked example – transcribe and translate

**A DNA template strand reads TAC GGA TTT.
Give the mRNA and say how many amino acids result.**

- mRNA is built **complementary** to the template, with **U in place of T**.
- TAC → AUG; GGA → CCU; TTT → AAA.
- mRNA: AUG CCU AAA – and **AUG is always the start codon**.
- 3 codons ⇒ **3 amino acids**; each tRNA anticodon pairs with one codon.

A → U (never T) when transcribing. **Codon** is on the mRNA, **anticodon** on the tRNA, and the **triplet** on the DNA – do not mix the three names.

Topic 6 – key takeaways

1

Base pairing

A–T (2 bonds), C–G (3);
antiparallel

2

Replication

semi-conservative; leading &
lagging strands

3

Code

triplets; transcription then
translation

4

Mutations

substitution vs frameshift (indel)

Check yourself

- 1 How many hydrogen bonds join C and G?
- 2 What does “semi-conservative” mean?
- 3 Where does translation take place?
- 4 Which mutation causes a frameshift?



Answers 1. three 2. each new molecule keeps one old strand 3. at the ribosome
4. deletion or insertion